A REVERSE ENGINEERING APPROACH FOR THE PRODUCTS DEVELOPMENT

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ABSTRACT: Recent technological developments have made easier the application of reverse engineering. In this paper, a reverse engineering approach for the development of the products has been presented. This approach has been based on the scanning of the initial product, followed by the redesign of the initial product, the manufacturing of the redesigned product through a 3D printer and the quality inspection of the redesigned product. A system for the using of a such approach has been depicted and a case study illustrates the application of the reverse engineering approach.
KEY WORDS: reverse engineering, 3D scanning, 3D printing, quality inspection.

1. INTRODUCTION

Reverse engineering is a modern process that allows the reconstruction of a product and the preservation of its original form [4, p.2]. Reverse engineering is also used for the development of a model for analysis, based on data, information and knowledge previously obtained [4, p.2].

Through the reverse engineering a product can be conversed in a digital prototype, which can be re-designed and manufactured by existing technologies. Recent technological developments in different fields [1,2,3] have made easier the applicationof reverse engineering, shortening the time required to manufacture a product [4].

2. A REVERSE ENGINEERING APPROACH FOR PRODUCTS DEVELOPMENT

Areverse engineering approach can start with the scanning of the initial product using the Shining3D©Scaner based on the Blue Light Scanning Technology [6]. The scanned 3D data are collected as points cloud of the geometry of the initial product. Next, the data are transferred in the ShiningForm XOR software, where the redesign of the initial product is performed.

Then, the redesigned product is manufactured through the 3D printer Inspire©S200 [7]. Finally, the inspection of the redesignedproduct's quality it is accomplished by scanning the manufactured product and comparing the scanned data with the3D modelof the redesigned product using the ShiningFormXOVsoftware[6]. Thisreverse engineering approach for the development of products it is shown in figure 1.

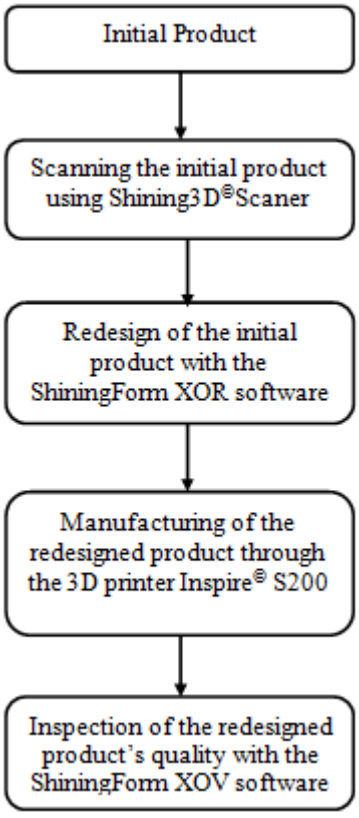


Figure 1. Areverse engineering approach for the development of products

A system for a such reverse engineering approach has been purchased within the project POSDRU/161/2.1/G/133930 "Support for a Successful Career in Reverse Engineering" [5], which it isdepicted in figure 2.

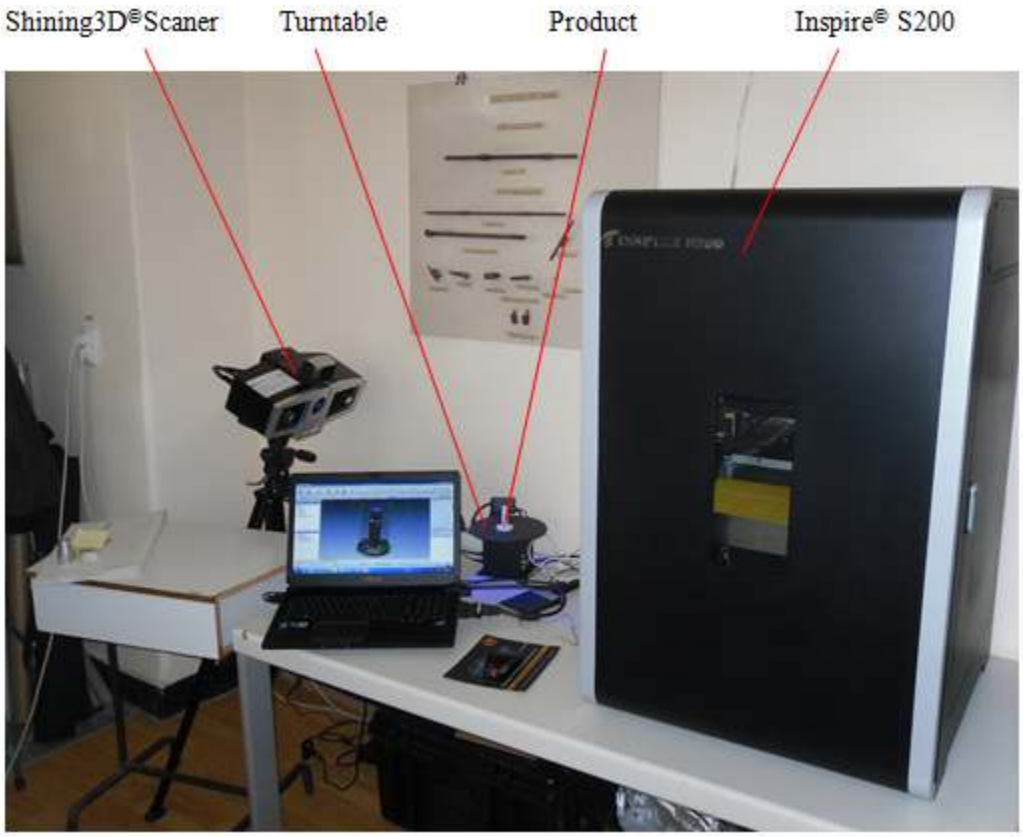


Figure 2. The reverse engineering system

3. CASE STUDY

We will illustrate the application of the reverse engineering approach in the case of an initial product (a flange).The research has been carried out within the Nonconventional Technologies Laboratory of the Industrial Engineering Department of the University of Oradea.

3.1 Scanning the initial product

The data collection of the initial productwas based on the following steps:

a) scanning of the initial product and aligning of the resulting scans using the Shining3D©Scaner and its software;

b) obtaining the points cloud of the geometry of the initial product with the same software;

c) export of the points cloud in a format that is recognized by the ShiningForm XOR software. Figure 3 presents the results of the scanned data using the Shining3D©Scaner.

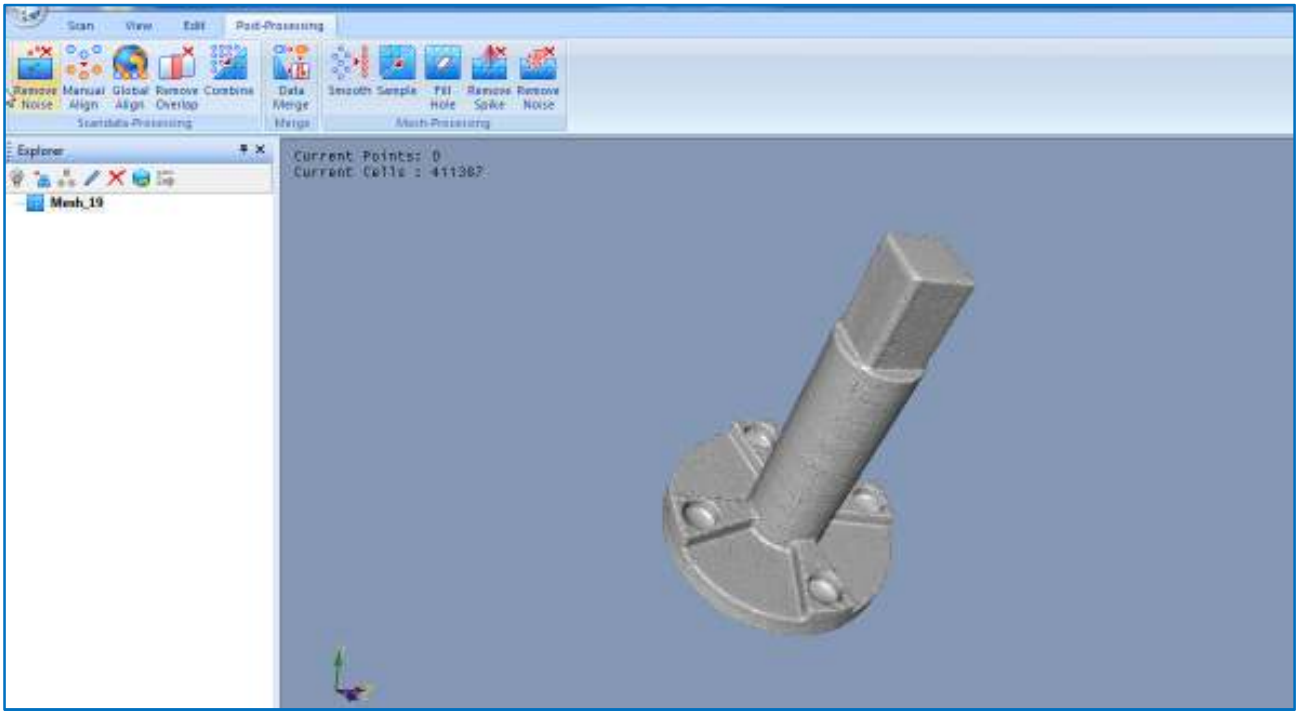


Figure 3. The points cloud of the geometry of the initial product

3.2 Redesign of the initial product

The redesign of the initial product was achieved by:

a) importing, getting regions and the alignment of the points cloud with the planes of the reference trihedral system (figure 4);

b) redesign of the entities of the initial product. Figures 5and 6 depict the redesign of an entity of the product. The redesigned product is presented in figure 7;

c) import of the redesigned product in Solid Edge and its export in a ".stl" format, which is recognized by the 3D printer.

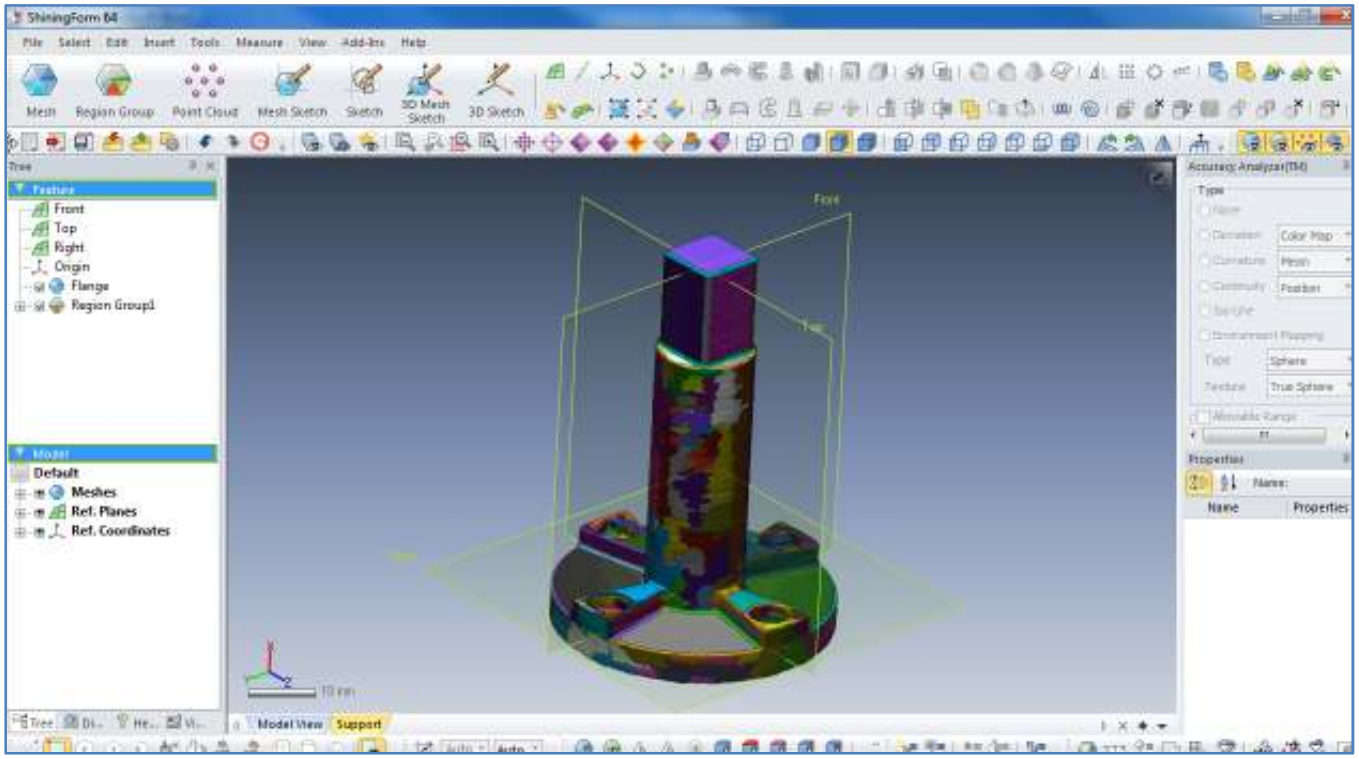


Figure 4. The alignment of the points cloud

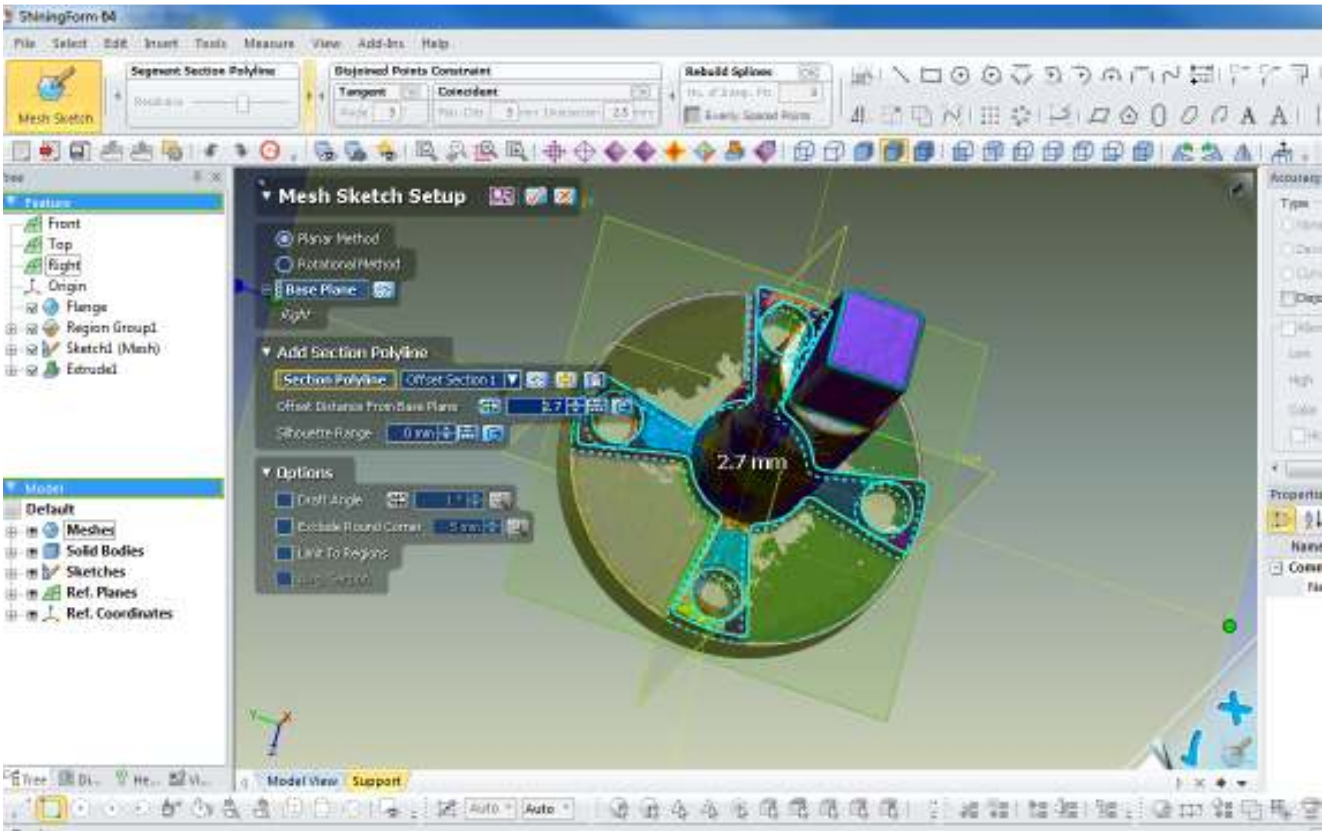


Figure 5. The redesign of an entity of the product

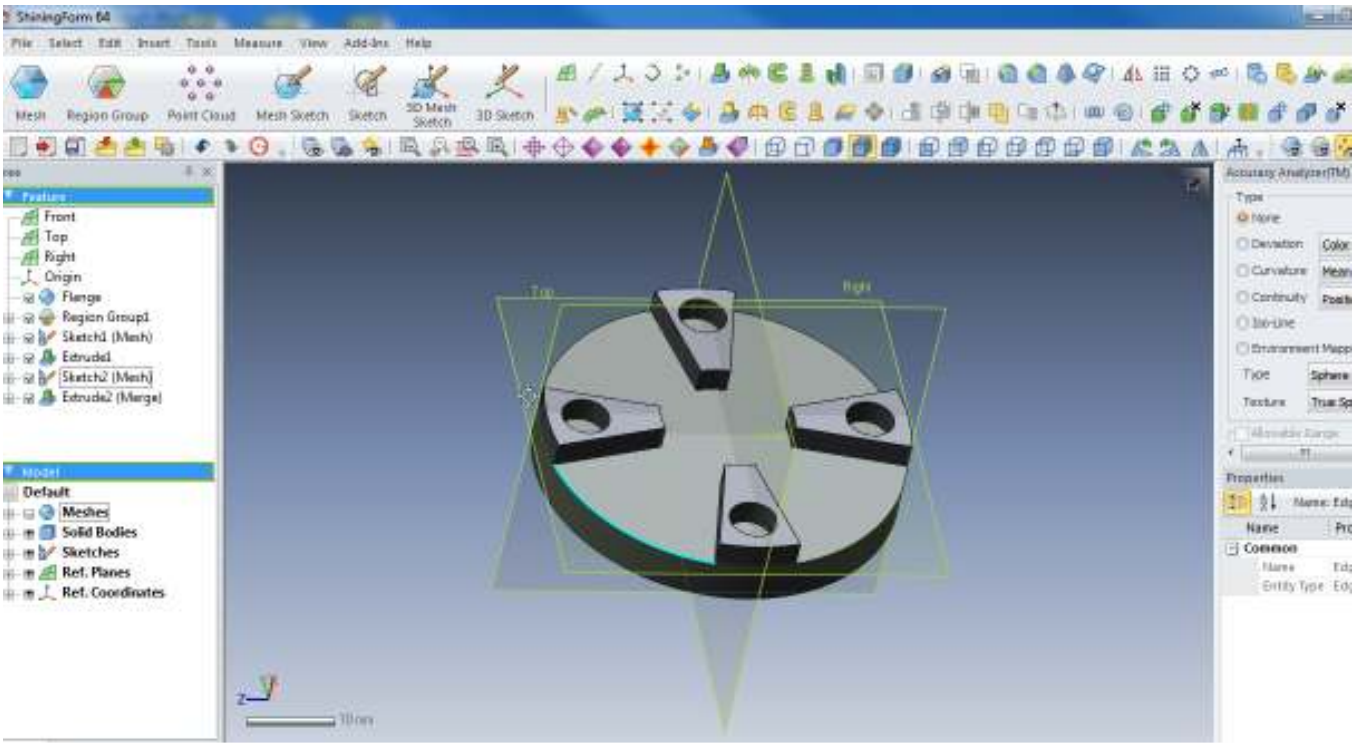


Figure 6. The result of the redesign of an entity of the product

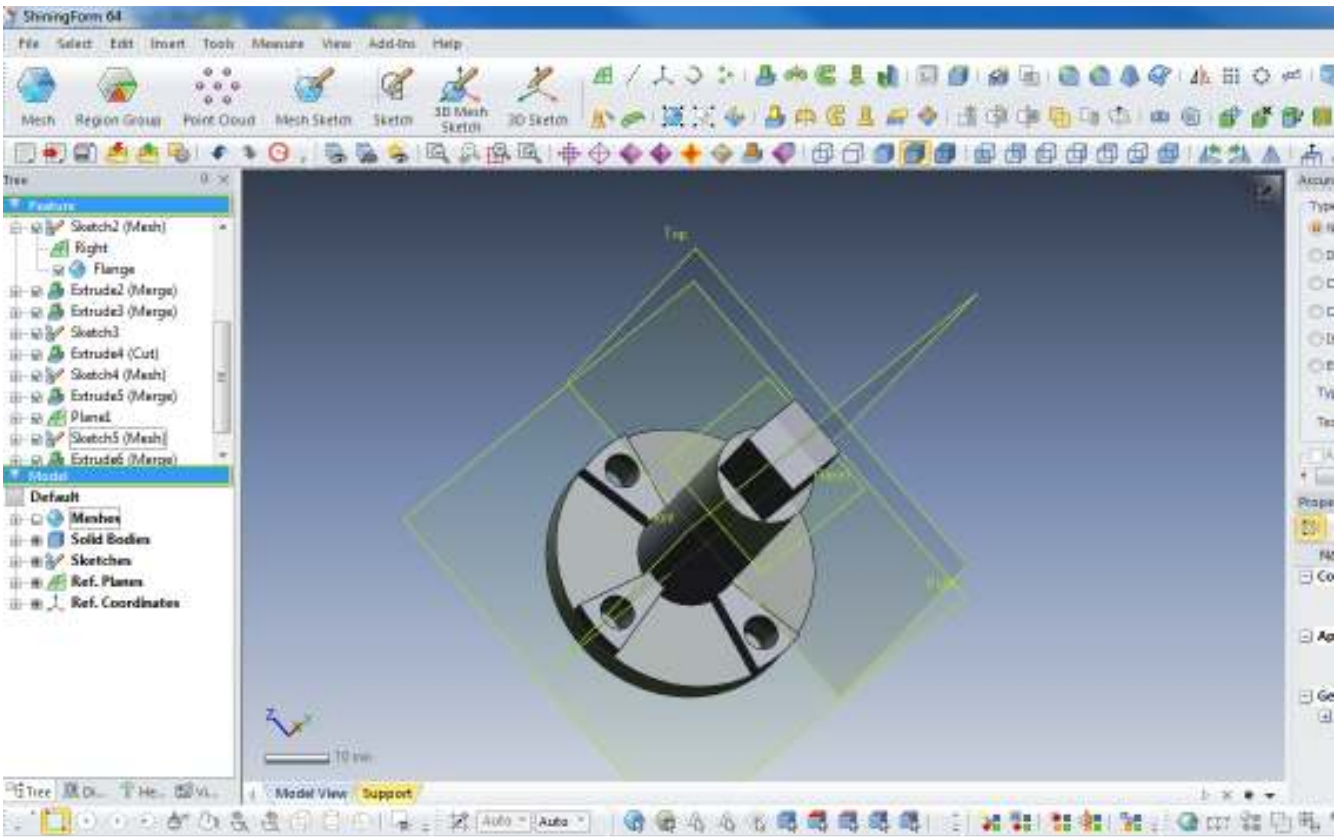


Figure 7. The redesigned product

3.3 Manufacturing of the redesigned product

The manufacturing of the redesigned product was performed through the 3D printer Inspire© S200, using ABS material.

The result of the 3D printing process it is shown in figure 8.

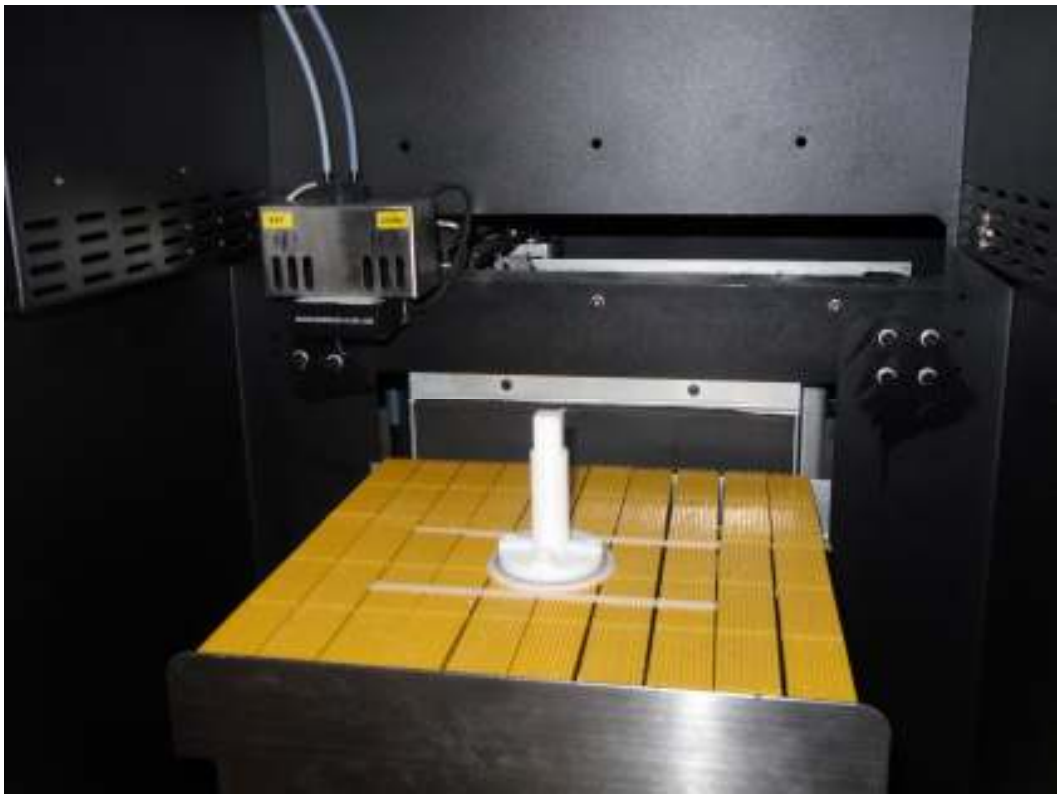


Figure 8. Manufacturing of the redesigned product

3.4 Inspection of the quality of the redesigned product

The inspection of the product's quality was achieved with the ShiningForm XOV software:

a) scanning of the redesigned product through the same steps presented in subchapter 3.1;

b) import of the scanned redesigned product and its 3D model in the ShiningForm XOV software;

c) alignment of the scanned redesigned product with the 3D model;

d) comparing the scanned redesigned product with its 3D model (figure 9);

e) generating the quality report (figure 10).

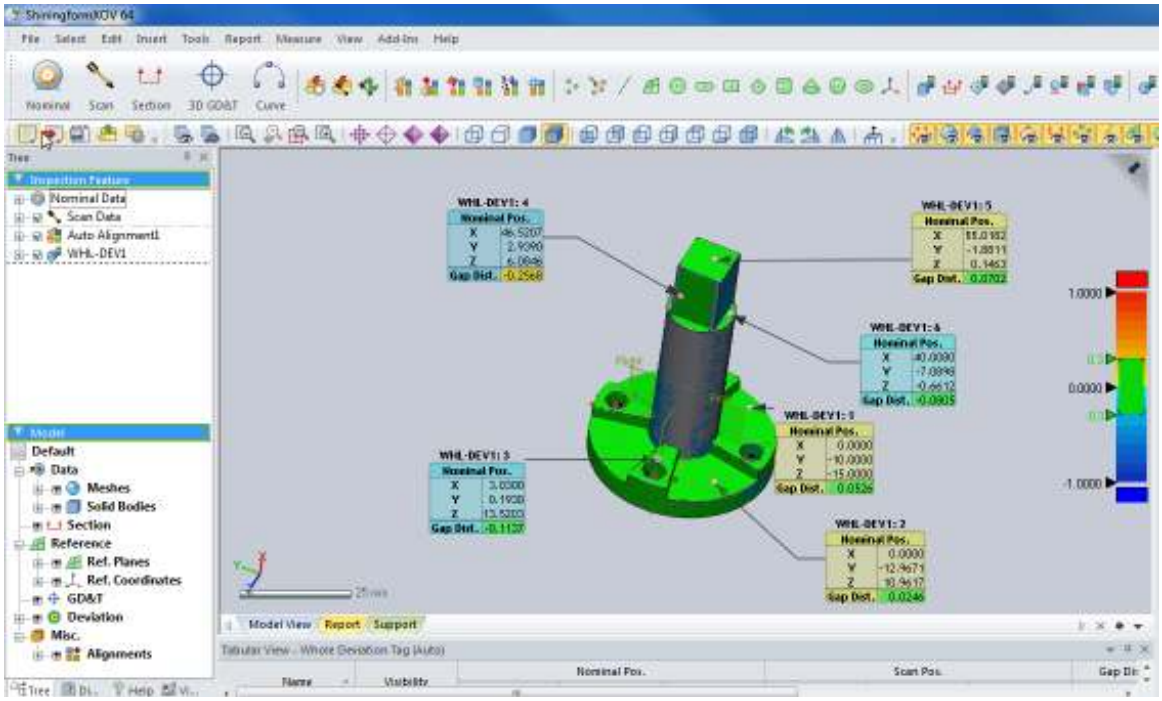
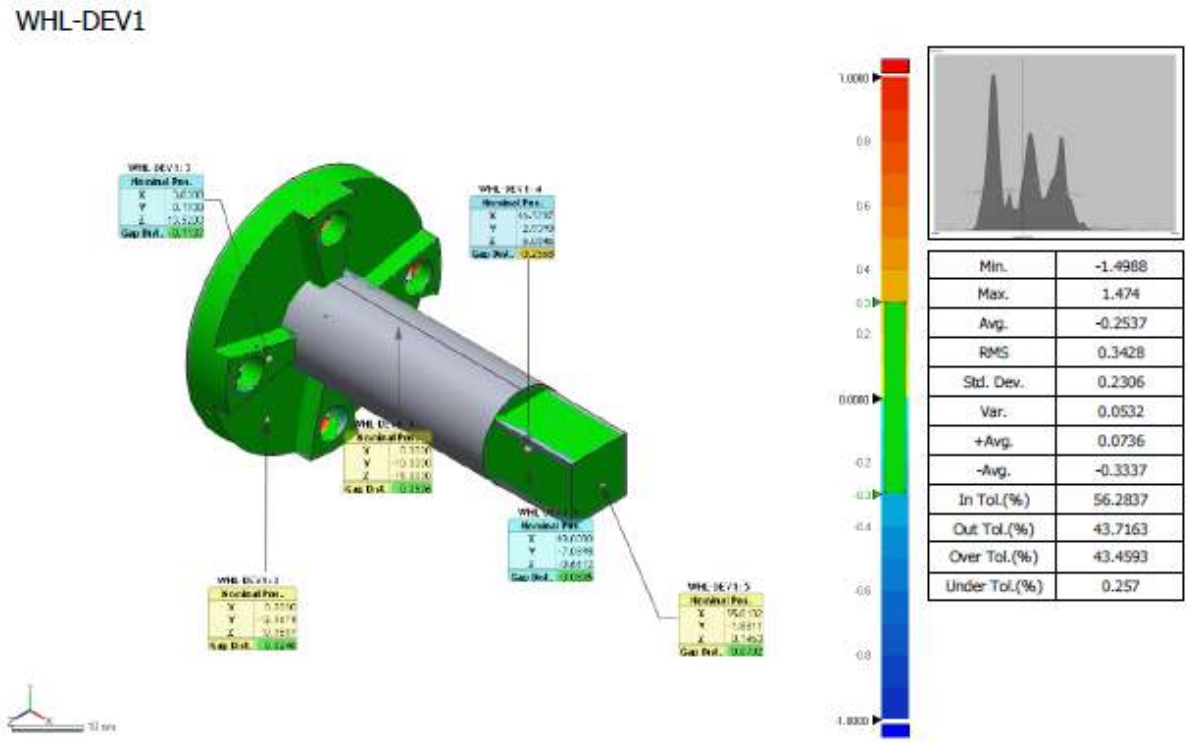


Figure 9. Comparison of the scanned redesigned product with its 3D model



Name	Nominal Pos.			Scan Pos.			Gap Dist.	Tolerance
	X	Y	Z	X	Y	Z		
WHL-DEV1: 1	0	-10	-15	0.0526	-10	-15	0.0526	±0.3
WHL-DEV1: 2	0	-12.9671	10.9617	0.0246	-12.9671	10.9617	0.0246	±0.3
WHL-DEV1: 3	3.03	0.193	13.5203	2.9163	0.193	13.5203	-0.1137	±0.3
WHL-DEV1: 4	46.5207	2.939	6.0846	46.5207	2.939	5.8278	-0.2568	±0.3
WHL-DEV1: 5	55.0182	-1.8811	0.1463	55.0884	-1.8811	0.1463	0.0702	±0.3
WHL-DEV1: 6	40.008	-7.0898	-0.6612	39.9275	-7.0898	-0.6612	-0.0805	±0.3
Min.	0.0000	-12.9671	-15.0000	0.0246	-12.9671	-15.0000	-0.2568	
Max.	55.0182	2.9390	13.5203	55.0884	2.9390	13.5203	0.0702	

Figure 10. The quality report

4. CONCLUSIONS

Recent technological developments have made easier the application of reverse engineering. In this paper, a reverse engineering approach for the products development has been presented as well as a system for the using a such approach. A case study illustrates the application of the reverse engineering approach.

5. ACKNOWLEDGEMENTS

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